

WHAT IS CLAIMED IS:

1. A digital watermark detection method of detecting watermark information embedded in an input image signal, comprising:

5 extracting a specific frequency component signal having a phase from the input image signal;

controlling the phase of the specific frequency component signal;

10 acquiring a cross-correlation value between the phase-controlled specific frequency component signal and the input image signal; and

detecting the watermark information from the cross-correlation value.

15 2. A digital watermark detection method of detecting watermark information embedded in an input image signal, comprising:

computing an auto-correlation function of the input image signal;

20 generating a specific frequency component signal by filtering the auto-correlation function; and

detecting the watermark information from the specific frequency component signal.

25 3. A digital watermark detection method of detecting watermark information embedded in an input image signal, comprising:

computing an auto-correlation function of the input image signal;

generating a first accumulation signal by  
accumulating the auto-correlation function for a first  
period of time;

extracting a specific frequency component signal  
5 having an amplitude from the first accumulation signal;

normalizing the amplitude of the specific  
frequency component signal;

generating a second accumulation signal by  
accumulating the normalized specific frequency  
10 component signal for a second period of time longer  
than the first period of time; and

detecting the watermark information from the  
second accumulation signal.

4. A digital watermark detection apparatus which  
15 detects watermark information embedded in an input  
image signal, comprising:

an extraction unit configured to extract a  
specific frequency component signal having a phase from  
the input image signal;

20 a controller which controls the phase of the  
specific frequency component signal;

a correlator which computes a cross-correlation  
value between the phase-controlled specific frequency  
component signal and the input image signal; and

25 a detector unit configured to detect the watermark  
information from the cross-correlation value.

5. The digital watermark detection apparatus

according to claim 4, wherein the detector unit detects the watermark information by determining a polarity of a peak in the cross-correlation value.

5           6. A digital watermark detection apparatus which detects watermark information embedded in an input image signal, comprising:

          a correlator which computes an auto-correlation function of the input image signal;

          a generator which generates a specific frequency  
10       component signal by filtering the auto-correlation function; and

          a detector unit configured to detect the watermark information from the specific frequency component signal.

15           7. The digital watermark detection apparatus according to claim 6, wherein the correlator comprises a controller which controls a phase of the input image signal to generate a phase-controlled input image signal, the correlator computing, as the auto-  
20       correlation coefficient, a correlation value between the phase-controlled input image signal and the original input image signal.

          8. The digital watermark detection apparatus according to claim 6, wherein the correlator computes  
25       the auto-correlation function based on result obtained by thinning pixel of the input image signal.

          9. The digital watermark detection apparatus

according to claim 6, wherein the detector unit detects the watermark information by determining a polarity of a peak of the specific frequency component signal.

10. The digital watermark detection apparatus  
5 according to claim 6, wherein the detector unit detects the watermark information using at least first and second detection manners, the detector unit determining that the watermark information is embedded, if the detection results are coincide to each other.

10 11. A digital watermark detection apparatus which detects watermark information embedded in an input image signal, comprising:

a correlator which computes an auto-correlation function of the input image signal;

15 a first accumulator which accumulates the auto-correlation function for a first period of time to generate a first accumulation signal;

an extraction unit configured to extract a specific frequency component signal from the first  
20 accumulation signal;

a normalizing unit configured to normalize an amplitude of the specific frequency component signal;

a second accumulator which accumulates the normalized specific frequency component signal for a  
25 second period of time longer than the first period of time to generate a second accumulation signal; and

a detector unit configured to detect the watermark

information from the second accumulation signal.

12. The digital watermark detection apparatus according to claim 11, wherein the correlator comprises a controller which controls a phase of the input image  
5 signal to generate a phase-controlled input image signal, the correlator computing, as the auto-correlation coefficient, a correlation value between the phase-controlled input image signal and the original input image signal.

10 13. The digital watermark detection apparatus according to claim 11, wherein the correlator computes the auto-correlation function based on result obtained by thinning pixel of the input image signal.

14. The digital watermark detection apparatus  
15 according to claim 11, wherein the detector unit detects the watermark information by determining a polarity of a peak of the specific frequency component signal.

15. The digital watermark detection apparatus  
20 according to claim 11, wherein the detector unit detects the watermark information by determining a level of the second accumulation signal using a threshold value that is changed in accordance with the second period of time.

25 16. The digital watermark detection apparatus according to claim 11, wherein the detector unit detects the watermark information using at least first

and second detection manners, the detector unit determining that the watermark information is embedded, if the detection results are coincide to each other.

17. The digital watermark detection apparatus  
5 according to claim 11, wherein at least one of the correlator, the first accumulator, the normalizing unit, and the second accumulator includes a processor, and which further comprising a controller which controls an operation amount of the correlator per unit  
10 time in accordance with a throughput of the processor.

18. The digital watermark detection apparatus according to claim 17, wherein the controller periodically stops computation of the correlator to reduce the operation amount, if the throughput is lower  
15 than a threshold value.

19. The digital watermark detection apparatus according to claim 11, wherein at least one of the correlator, the first accumulator, the normalizing unit, and the second accumulator includes a processor,  
20 and which further comprising a controller which periodically stops computation of the correlator and increases the second period of time, if the throughput is lower than a threshold value.

20. The digital watermark detection apparatus  
25 according to claim 11, further comprising an image rotation unit located before the correlator and configured to perform an image rotation operation on

the input image signal.

21. The digital watermark detection apparatus according to claim 20, wherein the image rotation unit comprises a line buffer which reads a plurality of line components of the input image signal at a time and temporarily accumulates them, and a read unit configured to read the accumulated line components with reading portions of the line components being shifted to one another, and to supply the read line components to the correlator.

22. The digital watermark detection apparatus according to claim 20, wherein the read unit shifts the reading portions of the line component in units of a given number of pixels of the input image signal.

23. The digital watermark detection apparatus according to claim 11, wherein the detector unit detects a level of the second accumulation signal, by performing a determination using a threshold value changed in accordance with the second accumulation period of time.

24. The digital watermark detection apparatus according to claim 11, wherein the detector unit detects the watermark information using at least first and second detection manners, the detector unit determining that the watermark information is embedded, if the detection results are coincide to each other.

25. The digital watermark detection apparatus

according to claim 11, further comprising a third  
accumulator which accumulates the normalized specific  
frequency component signal for a third period of time  
longer than the first period of time and shorter than  
5 the second period of time, to generate a third  
accumulation signal, and wherein the detector unit  
provisionally detects the watermark information from  
the third accumulation signal a given number of times  
to obtain a plurality of provisional detection results,  
10 the detector unit determining that the detection  
results based on the second accumulation signal is  
valid, if more than half of the provisional detection  
results are coincide.